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SOME IGNEOUS ROCKS FROM THE ORTIZ MOUNTAINS, NEW MEXICO

I. H. OGILVIE
With Chemical Analyses by M. W. Adams

The Ortiz Mountains are a deeply sculptured laccolith, lying on the San Pedro quadrangle, some twenty-five miles east of Albuquerque. They are roughly circular in outline with a diameter of about five miles, and have a relief of about 3,000 ft., the highest peak rising to an altitude of 8,998 ft. They afford interesting data on erosion in an arid climate; on Mesozoic stratigraphy and paleontology; on the events of the Pleistocene period in the region south of the ice sheets; and on petrology. The present paper is preliminary, and deals with a few of the more conspicuous rock types.

The quantitative system is used in classification, the names being based on analyses. The following table indicates the rock types represented.

TABLE I

Class	Order	Rang	Subrang	Old Name
I. Persalane.....	4. Canadare-Britannare	2. Toscanase	4. Lassenose	Dacite
		3. Coloradase	4. Yellowstonose	Dacite
II. Dosalane......	5. Germanare	2. Monzonase	3. Monzonose	Diorite
			4. Akerose	Diorite
		3. Andase	4. Andose	Diorite
	6. Norgare	2. Essexase	4. Essexose	Essexite
III. Salfemane.....	5. Gallare	4. Auvergnase	3. Auvergnose	Andesite

The distribution of these types is found to be noteworthy: The main mass of the laccolith is of the more femic types, essexose and Auvergnose (andesites); the sheets which border the mass are of the most salic types, the persalanes (dacites); while the spurs and flanks of the mountains, lying between the above are of the intermediate types. It should however be noted that all of the rocks are intermediate when compared with igneous rocks in general.

This laccolith is the largest of four, lying in a north and south line. The northernmost, the Cerrillos Hills, has been described by D. W. Johnson.[1] The Ortiz is the next group, while the San Pedro and the South Mountains make up the southernmost groups. It is apparent that these groups are closely related and they probably constitute a single comagmatic region.

The scope of the present paper is primarily chemical. A brief statement of field relations, texture, and mineralogy will be given for each type analyzed, but a detailed discussion of optical characters will not be undertaken in this preliminary paper. It is probable that all the types here discussed are of post-Cretaceous age.

LAURVIKOSE—LASSENOSE I. 4–5.2.4 (DACITE)

Rocks of this type are gray, porphyritic, and form sheets on all sides of the main mass. The phenocrysts are of pink or white feldspar, the ground mass is phanerocrystalline but fine-grained.

Microscopically the phenocrysts are found to be soda orthoclase with more or less concentric structure. A few phenocrysts of green

TABLE II

CHEMICAL COMPOSITION OF LASSENOSE

	I	MOL. PROP.	II	MOL. PROP.	NORMS		
						I	II
SiO_2.....	63.11	1.052	62.36	1.039	Qu.....	12.72	11.76
Al_2O_3....	16.75	0.164	17.78	0.175	Or.....	20.57	20.02
Fe_2O_3....	2.68	0.017	2.74	0.017	Ab.....	39.82	39.82
FeO......	1.39	0.019	1.66	0.024	An.....	14.18	17.51
MgO.....	1.22	0.040	1.37	0.034	Diop...	4.32	2.38
CaO.....	3.88	0.070	4.49	0.080	Hyp....	2.00	2.30
Na_2O....	4.76	0.076	4.75	0.076	Mag...	2.32	3.94
K_2O.....	3.48	0.037	3.37	0.036	Hem...	1.12	
H_2O+...	1.09	.....	0.26	.....	Ilm....	1.52	1.37
H_2O-...	0.32	.....	0.11	.....	Ap.....	0.34	0.67
CO_2.....	none	.....	none	.....			
TiO_2.....	0.80	0.010	0.73	0.009			
ZrO_2.....	none	.....	none	.....			
P_2O_5.....	0.25	0.001	0.29	0.002			
S........	0.03	.....	0.03	.....			
MnO.....	0.11	0.001	0.12	0.002			
BaO.....	0.16	0.001	0.03	.....			
Total..	100.03		100.09				

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[1] *School of Mines Quarterly*, 1903–4.

hornblende and of quartz may also be seen. The ground mass consists of fine grains of plagioclase with augite and magnetite.

Analyses 1 and 2 were from specimens taken from two sheets, respectively on the west and the southwest of the group. It is noteworthy that all of the FeO is in magnetite and ilmenite and that the normative diopside and hypersthene are of a pure magnesian variety. The second analysis is close to a division line in both order and rang, so this type is properly a Laurvikose-Yellowstonose-Lassenose. Norm and mode agree fairly well.

Yellowstonose. I. 4. 3. 4 (Dacite)

This type is in all megascopic and microscopic respects similar to the Lassenose. It is a porphyritic dacite, and occurs in sheets. The sole important difference is that potash, and hence the sum of the alkalies, is lower in Yellowstonose, thus placing the rock in rang 3, in spite of the fact that lime and soda are present in approximately equal amounts in both types. The second analysis (IV) approaches rang 2 and might be termed a Lassenose-Yellowstonose.

The sheets from which specimens for analysis were taken are respectively on the northeast and southeast sides of the mountains.

TABLE III

Chemical Composition of Yellowstonose

	III	Mol. Prop.	IV	Mol. Prop.	Norms		
						III	IV
SiO_2.....	62.48	1.041	62.61	1.032	Qu.....	15.06	16.98
Al_2O_3....	18.07	0.177	17.54	0.172	Or.....	12.79	12.79
Fe_2O_3....	2.61	0.016	2.72	0.017	Ab.....	39.82	41.39
FeO......	1.97	0.028	1.52	0.021	An.....	21.68	19.46
MgO.....	1.34	0.034	1.39	0.035	Diop...	0.22	.....
CaO.....	4.67	0.084	4.18	0.075	Hyp....	4.12	3.50
Na_2O....	4.69	0.076	4.88	0.079	Mag...	3.71	3.48
K_2O.....	2.16	0.023	2.21	0.023	Ilm....	1.22	1.22
H_2O+...	0.52	.....	1.52	.....	Ap.....	0.67	0.67
H_2O-...	0.12	.....	0.22	.....	Hem...	.....	.48
CO_2.....	none	.....	none	.....			
TiO_2.....	0.60	0.008	0.60	0.008			
ZrO_2.....	none	.....	none	.....			
P_2O_5.....	0.28	0.002	0.27	0.002			
S........	0.03	.....	0.06	.....			
MnO.....	0.17	0.002	0.14	0.002			
BaO.....	0.09	0.001	0.18	0.001			
Total...	99.79		100.04				

Shoshonose-Monzonose-Akerose-Andose. II. 5. 2–3. 3–4. (Diorite)

This rock is gray, fine-grained, and holocrystalline. It is not porphyritic. The specimen from which the analysis was made is from a spur of about 7,500 feet in altitude on the southeastern side of the group.

Chemically the type is remarkable in being exactly on the division line between rangs 2 and 3, and nearly so between subrangs 3 and 4. Hence the complex name.

Microscopically it contains orthoclase, two plagioclases, augite, a green pleochroic hornblende, titanite, magnetite, apatite, and a small amount of nepheline.

TABLE IV

Chemical Composition of Shoshonose-Monzonose-Akerose-Andose

	V	Mol. Prop.		Norm
SiO_2	55.04	0.917	Or	25.58
Al_2O_3	20.45	0.200	Ab	36.15
Fe_2O_3	2.09	0.013	An	20.85
FeO	2.71	0.038	Ne	2.84
MgO	1.63	0.041	Di	4.48
CaO	5.82	0.104	Ol	2.84
Na_2O	4.92	0.079	Mg	3.02
K_2O	4.29	0.046	Ilm	2.28
H_2O+	0.69	.....	Ap	1.01
H_2O-	0.10	.....		
CO_2	none	.....		
TiO_2	1.17	0.015		
ZrO_2	none	.....		
P_2O_5	0.37	0.003		
S	0.04	.....		
MnO	0.26	0.004		
BaO	0.19	0.001		
Total	99.77			

Akerose. II. 5. 2. 4 (Diorite)

The type is essentially similar to the last, except that its color is pinker in tone, due to the presence of considerable red orthoclase. No nepheline is present, but there is a small amount of quartz. It forms the mountain 8,200 feet high on the southeastern side of the group.

TABLE V

CHEMICAL COMPOSITION OF AKEROSE AND ANDOSE

	VI	MOL. PROP.	VII	MOL. PROP.	VIII	MOL. PROP.
SiO_2	57.70	0.961	55.46	0.924	54.86	0.914
Al_2O_3	19.63	0.192	18.15	0.178	19.33	0.189
Fe_2O_3	3.30	0.021	3.93	0.024	3.35	0.021
FeO	1.60	0.022	3.42	0.047	2.59	0.036
MgO	1.21	0.030	3.19	0.080	3.05	0.076
CaO	5.14	0.091	7.37	0.132	7.69	0.138
Na_2O	5.42	0.087	3.44	0.055	4.38	0.071
K_2O	3.74	0.039	2.14	0.022	2.33	0.024
H_2O+	0.24	.....	0.38	.....	0.80	.....
H_2O-	0.13	.....	0.24	.....	0.16	.....
CO_2	none	.....	none	.....	none	.....
TiO_2	1.10	0.014	1.20	0.015	1.32	0.016
ZrO_2	none	.....	none	.....	none	.....
P_2O_5	0.29	0.002	0.38	0.003	0.41	0.003
S	0.06	0.002	0.04	.....	0.06	.....
MnO	0.17	0.001	0.21	0.003	0.22	0.003
BaO	0.09	0.001	0.07	.....	0.17	0.001
Total	99.77		99.62		100.72	

NORMS			
	VI	VII	VIII
	Akerose	Andose	Andose
Qu	1.38	8.82	2.58
Or	21.68	12.23	13.34
Ab	45.59	28.82	37.20
An	18.35	28.08	26.13
Diop	4.32	4.85	7.81
Hyp	1.00	7.16	4.23
Hem	1.92	....	....
Mag	2.09	5.57	4.87
Ilm	2.13	2.28	2.43
Ap	.67	1.01	1.01

ANDOSE. II. 5. 3. 4 (DIORITE)

This rock is in most respects identical with the preceding types but differs in having a tendency toward a porphyritic texture. It forms the massif of Lone Mountain, a partially isolated peak to the southeast of the Ortiz group. Its consanguinity with the main stock is evident from the analyses. Two of these were made, from the top and side respectively, and these are given in the preceding table. They are placed next the Akerose for comparison, this latter type being most closely related chemically and also the nearest in space. The most noteworthy differences are the higher lime and lower potash of the Andose.

ESSEXOSE. II. 6. 2. 4 (DIORITE AND ESSEXITE)

This rock type is an exceedingly common one, and is somewhat variable. It forms the outlying hills on the southeast, and usually forms the top of those with an altitude of about 8,300 feet. It is from one of these that X is taken. IX is from the top of the highest mountain. The recalculated analysis requires nepheline. This is sometimes present in the slides; more often a porphyritic structure

TABLE VI

CHEMICAL COMPOSITION OF ESSEXOSE

	IX	MOL. PROP.	X	MOL. PROP.	NORMS		
						IX	X
SiO_2.....	51.42	0.857	51.19	0.850	Or.....	23.91	28.36
Al_2O_3....	19.40	0.190	21.16	0.208	Ab.....	22.01	18.34
Fe_2O_3....	3.72	0.023	2.85	0.018	Ne.....	12.21	15.34
FeO......	3.33	0.046	2.31	0.032	An.....	17.24	19.18
MgO....	2.56	0.064	2.34	0.059	Diop....	14.48	8.86
CaO.....	7.80	0.139	6.79	0.121	Ol.....	0.90	1.26
Na_2O....	5.28	0.085	5.43	0.088	Mag...	5.34	4.18
K_2O.....	3.96	0.043	4.78	0.051	Ilm....	2.74	3.04
H_2O+...	0.49	.....	0.54	.....	Ap.....	1.34	1.34
H_2O-...	0.04	.....	0.08	.....			
CO_2.....	none	.....	none	.....			
TiO_2.....	1.39	0.018	1.54	0.020			
ZrO_2.....	none	.....	none	.....			
P_2O_5.....	0.53	0.004	0.62	0.004			
S........	0.03	.....	0.04	.....			
MnO.....	0.23	0.003	0.25	0.004			
BaO.....	0.21	0.001	0.11	0.001			
Total..	100.39		100.03				

is developed with large phenocrysts of olivine and no nepheline. The olivine phenocrysts contain inclusions of magnetite, apatite, biotite, plagioclase; a few phenocrysts of twinned augite are occasionally present. In this variety the groundmass contains intergrowths of feldspars, and broad laths of both orthoclase and plagioclase. The nepheline-bearing variety has a granitic texture, and lacks olivine.

AUVERGNOSE III. 5. 4. 3 (ANDESITE)

This rock is holocrystalline, dark-bluish gray, and contains many basic segregations. It occupies the central part of the group and lower levels of the surrounding hills whose tops are less basic.

TABLE VII

CHEMICAL COMPOSITION OF AUVERGNOSE

	XI	MOL. PROP.	NORM	
				XI
SiO_2	49.09	0.818	Or	2.22
Al_2O_3	15.11	0.148	Ab	27.25
Fe_2O_3	0.48	0.003	An	25.58
FeO	7.85	0.110	Diop	22.07
MgO	7.66	0.191	Hyp	4.65
CaO	11.03	0.196	Ol	9.08
Na_2O	3.24	0.052	Mag	0.70
K_2O	0.37	0.004	Ilm	6.54
H_2O+	0.39	.....	Ap	0.67
H_2O-	0.02	.....		
CO_2	none	.....		
TiO_2	3.40	0.043		
ZrO_2	none	.....		
P_2O_5	0.34	0.002		
S	0.06	.....		
MnO	0.25	0.004		
BaO	none	.....		
Cr_2O_3	0.04	.....		
Total	99.33			

In the following table the analyses are compared. The range of silica is moderate, from 63 to 49 per cent. Alumina is generally high and its range is not great. Iron and magnesia are uniformly low and of slight range, with the exception of II, Auvergnose. Lime is high and of great range; soda is moderate and of little range; potash is moderate and of considerable range. Titanium is almost invariably high; zirconia is entirely absent; baryta is high.

TABLE VIII

		SiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	CaO	Na_2O	K_2O	H_2O+	H_2O-	TiO_2	P_2O_5	S	MnO	BaO	Total
1	I.4.24	63.11	16.75	2.68	1.39	1.22	3.88	4.76	3.48	1.09	0.32	0.80	0.25	0.03	0.11	0.16	100.03
2	I.4.2.4	62.36	17.78	2.74	1.66	1.37	4.49	4.75	3.37	0.26	0.11	0.73	0.29	0.03	0.12	0.03	100.09
3	I.4.3.4	62.48	18.07	2.61	1.97	1.34	4.67	4.69	2.16	0.52	0.12	0.60	0.28	0.03	0.17	0.09	99.79
4	I.4.3.4	62.61	17.54	2.72	1.52	1.39	4.18	4.88	2.21	1.52	0.22	0.60	0.27	0.06	0.14	0.18	100.04
5	II.5 (2–3)(3–4)	55.04	20.45	2.09	2.71	1.63	5.82	4.92	4.29	0.69	0.10	1.17	0.37	0.04	0.26	0.19	99.77
6	II.5.2.4	57.70	19.63	3.30	1.60	1.21	5.14	5.42	3.74	0.24	0.13	1.10	0.29	0.06	0.17	0.09	99.77
7	II.5.3.4	55.46	18.15	3.93	3.42	3.19	7.37	3.44	2.14	0.38	0.24	1.20	0.38	0.04	0.21	0.07	99.62
8	II.5.3.4	54.86	19.33	3.35	2.59	3.05	7.69	4.38	2.33	0.80	0.16	1.32	0.41	0.06	0.22	0.17	100.72
9	II.6.2.4	51.42	19.40	3.72	3.33	2.56	7.80	5.28	3.96	0.49	0.04	1.39	0.53	0.03	0.23	0.21	100.39
10	II.6.2.4	51.19	21.16	2.85	2.31	2.34	6.79	5.43	4.78	0.54	0.08	1.54	0.62	0.04	0.25	0.11	100.03
11	III.5.4.3	49.09	15.11	0.48	7.85	7.66	11.03	3.24	0.37	0.39	0.02	3.40	0.34	0.06	0.25	none[1]	99.33

NOTE.—CO_2 and ZrO_2 being lacking in all of the analyses are not tabulated.

[1] Cr_2O_3 .04.

The Lassenoses and Yellowstonoses contain small amounts of gold, copper, antimony, lead, and bismuth.

A consideration of the serial chemical characters of the region brings out the fact that soda is practically constant and alumina nearly so. As silica decreases iron and magnesia increase but very slightly, and somewhat irregularly; on the other hand the increase in lime is regular and normal. Potash varies from 0.39 to 4.78, and its variations bear no definite relation to the decrease in silica, nor does the sum of the alkalies uniformly change. The sum of the alkalies invariably either equals or exceeds salic lime, which finds expression in the rang.

DEPARTMENT OF GEOLOGY
Columbia University